Simulated Results of Single Channel Demodulator using Costas Loop for Multicarrier Demodulator

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ABSTRACT
This paper present demodulation process of single carrier, which simulation result analyzed in MATLAB. Carrier recovery, symbol detection technique will be analyzed in MATLAB. Here rrc filter used for pulse shaping data, costas loop for carrier recovery and gardner algorithm for symbol detection at the end BER test result of demodulated signal shown

Keywords *– rrc filter, baseband signal, costas loop*

I. INTRODUCTION

With the popular demand of mobile satellite services like voice calls, short message services, video calls through satellite communications for terrestrial network multicarrier demodulator is very effective technique for receiving data instead of single carrier demodulator. This is especially true when the locations are dispersed over remote regions, and barely connectable via a terrestrial network infrastructure. In this case, satellite communications are an effective way to provide private or secure data networks. Satellite communications is becoming a viable means of providing a wide range of communications applications for both the commercial and military sectors. The most remote places on earth can have communications via satellite. the infrastructure, bandwidth, and availability of satellite communications is important for satellite communication multicarrier demodulator is solution of the power consumption instead of using single carrier technique so in order to need power consumption, space requirement for terrestrial network this project will be carried out. Multicarrier demodulator is very effective technique instead of single carrier demodulator. Multicarrier demodulator is beneficial for space requirement with using one four-channel demodulator instead of four different single carrier demodulator. using one multicarrier demodulator we can be recover more data which carried by different carrier frequencies. This will be design on software based so it also reduces complexity problems. In this paper simulation of single carrier demodulation has been reported here costas loop and gardner algorithm have been used for carrier recovery and symbol decoding respectively.

II. METHODOLOGY

Modulation is the process by which some characteristic of a carrier is varied in accordance with a modulating wave (signal) [1]. At the receiver end, demodulation must be accomplished to recognize the signals. The process of deciding which symbol was transmitted is referred to as a detection process. Typically, the receiver generates a signal that is phase-locked to the carrier. Carrier recovery is must important for demodulation. On the basis of analyzing the carrier recovery and symbol decoding algorithm simulate it by MATLAB is put forward. Following work, the functional simulation is accomplished in Verilog code on Modelsim simulator.

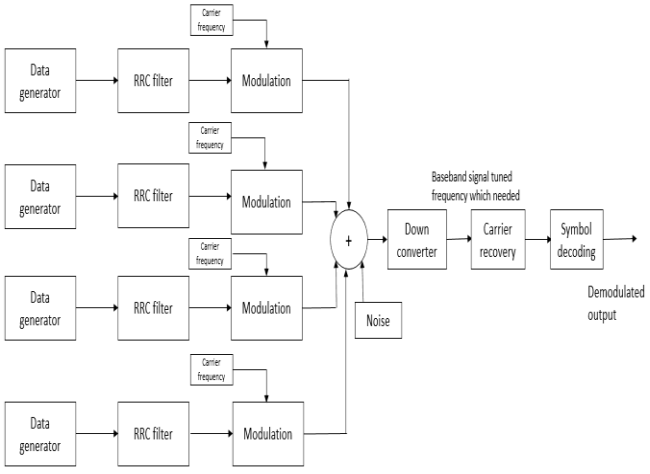

Fig.1 Block diagram of multicarrier demodulator

Block diagram of multicarrier demodulator as shown in fig.1 first of all data was generated which is random data which is passed through root raised cosine filter for pulse shaping binary data than modulation will be carried out after that noise will be added after modulation, then demodulation process comes in that down conversion, carrier recovery and symbol decoding is important parameters. At first for single carrier simulation process analyzed than same process will be used for multicarrier demodulation

2.1 Root raised cosine filter:

The Root Raised Cosine digital filter is a widely used pulse-shaping FIR filter in digital baseband communication systems. The design parameters of the filter implementation are strongly bound to the overall performance of the communication system rrc filter is cancel out harmonics of the binary data and shaping pulses which used to modulation here simulation result of pulse shaping using rrc filter shown in fig.2 which simulated in MATLAB. For simulation rrc filter roll of factor 0.25,samples per symbol is 4 have been used

Fig.2 Pulse shaping of data using rrc filter

2.2 Down conversion:

Down conversion of modulated signal is necessary to recover data for demodulation process using down converted signal converted to baseband signal which comes to zero IF so it can be easily proceed to demodulation baseband signal of single carrier modulated signal and its spectrum is shown in figure 3

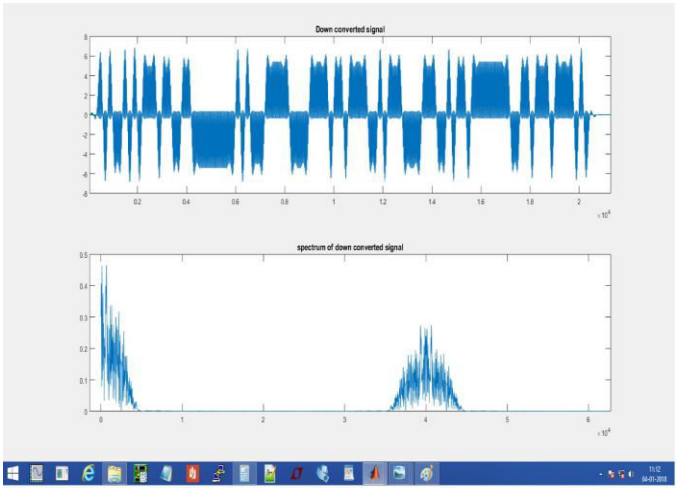

Fig.3 Baseband signal simulation in MATLAB

2.3Carrier recovery:

Coherent detection and demodulation requires the utilization of synchronization systems that extract carrier phase and frequency information from the received signal. Phase and frequency are two parameters used by synchronization systems, such as Phase-Locked Loops (PLL) to track, acquire and synchronize to the carrier of the received signal. The carrier is used in the receiver to synchronize to, as the residual energy at carrier frequency is considered to be wasted energy as it does not transmit any data. In practice, techniques that conserve power are of interest, hence communications systems use suppressed carrier modulation/demodulation techniques, which do not require a residual energy at the carrier frequency. Using suppressed-carrier modulation techniques, present a problem for PLLs, since in the absence of the carrier, PLLs cannot track, acquire and synchronize to the received signal. Therefore, another synchronization system must be used instead. An example of such a system is the Costas loop. The Costas loop is able to obtain the phase and frequency information of the modulated carrier and achieve phase tracking, acquisition and synchronization to this extracted carrier while demodulating and extracting the data contained in the received signal. The BPSK Costas loop block diagram is depicted in figure (2). It mainly consists of Phase Detector (PD), Low pass Filter (LPF), Loop Filter (LF) and Voltage Controlled Oscillator (VCO). The BPSK signals are sent to two multipliers of the upper branch called in-phase channel or I-channel and the lower branch called quadrature-phase channel or Q-channel respectively. The I-channel multiply the input by VCO's output, but the Q channel multiply input by VCO's output after 90-degree phase shift. The multiplier output of the I-channel and Q channel are passed through

the arm filters, which are low pass filters, then multiply together to get the error signal. Finally, the error signal is filtered by the loop filter, whose output is control voltage that can control VCO's phase and frequency. When the carrier frequency and phase generated by VCO are coincident with the input signal's carrier frequency and phase, the demodulated signal can be extracted from the I-channel.

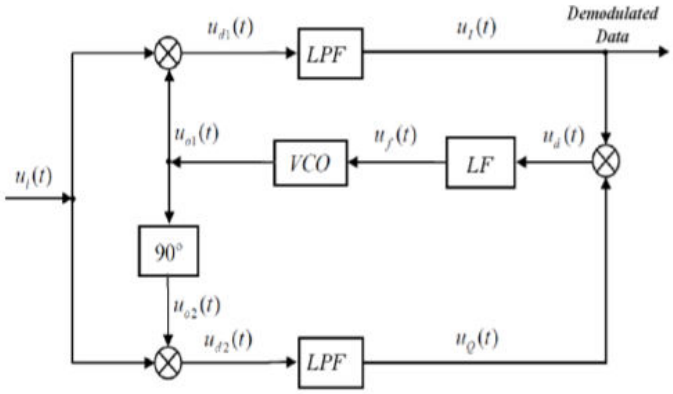

Fig. 4 costas loop block diagram

Costas loop simulation result as shown in following figure 5 which simulated in MATLAB

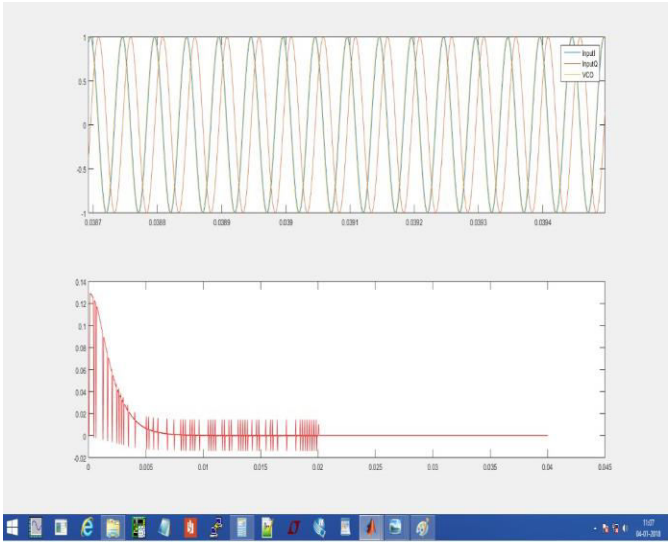

Fig. 5 costas loop simulation in MATLAB

2.4 Symbol timing recovery:

A digital communications receiver requires precise symbol synchronization before the transmitted information can be recovered. Gardner's algorithm is a synchronizer that can acquire and track timing with only two samples per symbol, and it does not require prior carrier synchronization.

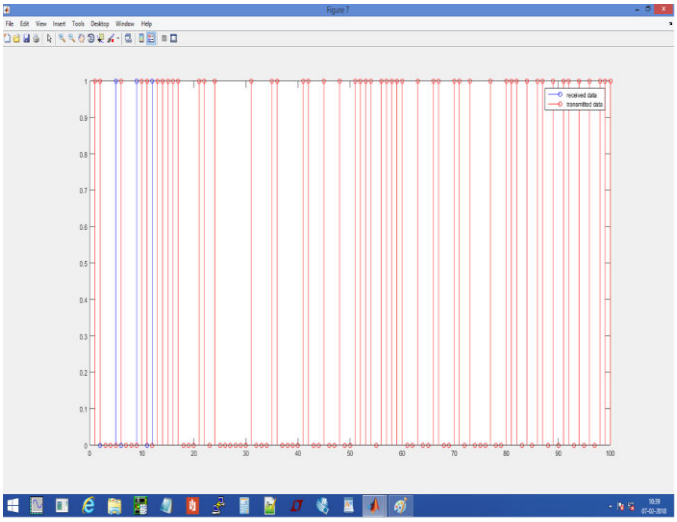

Fig.6 symbol detection simulation in MATLAB

III. SIMULATION RESULTS

The multicarrier demodulator is implemented first in MATLAB in order to verify the design of the system. Modulated data, down conversion of modulated signal, carrier recovery using costas loop, symbol decoding using gardner algorithm are simulated in MATLAB which simulation results as shown in above figures

IV. CONCLUSION

The costas loop is an effective close-loop coherent demodulator technique for demodulation of single channel which will be used for multicarrier demodulator

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